SUPPORT FOR THE AMENDMENTS

This Amendment cancels Claims 13-14; and amends Claims 12, 18-20 and 22. Support for the amendments is found in the specification and claims as originally filed. In particular, support for Claim 12 is found in canceled Claims 13-14 and in the specification at least at page 3, lines 6-15; page 4, lines 14-18; and page 8, lines 22-25. No new matter would be introduced by entry of these amendments.

Upon entry of these amendments, Claims 12, 15-22 and 26-29 will be pending in this application. Claim 12 is independent.

REQUEST FOR RECONSIDERATION

Applicants respectfully request entry of the foregoing and reexamination and reconsideration of the application, as amended, in light of the remarks that follow.

Applicants thank the Examiner for the courtesies extended to their representative during the July 22, 2003, personal interview.

As discussed at the interview, the present invention provides a glazing which affords exceptional laceration protection to persons striking against the glazing after it has shattered. The lacerations that result when a person strikes against a shattered laminated glazing are far more severe than those that result when a person strikes against an intact glazing surface, which breaks up only afterwards. The laceration protection achieved by the present invention is provided by a laminated glazing produced by adhering together, with an intercalary adhesive layer having a thickness of more than 0.76 mm, two sheets of glass each having a thickness of from 1.5 to 3 mm and having a core compressive stress in the central zone ranging from 20 to 50 MPa. The glazing, in a non-intact and bent state, has a Triple Laceration Index ("TLI") of 7 or less, indicative of superior anti-laceration properties.

The Triple Laceration Index is described in Pickard J., Brereton P., Hewson A.: An objective method of assessing laceration damage to simulate facial tissues - The Triplex Laceration Index - Proceeding of 17th Conference - American Association of Automotive Medicine 1973, pages 148-165 (copy attached).

Claims 12-19 and 26-29 are rejected under 35 U.S.C. §103(a) over U.S. Patent No. 5,397,647 ("Kramling") in view of U.S. Patent No. 3,558,415 ("Rieser"), or alternatively, Kramling in view of Rieser. In addition, Claims 20-22 are rejected under 35 U.S.C. §103(a) over Kramling in view of Rieser, or alternatively, Rieser in view of Kramling, and further in view of Admitted Prior Art at specification page 2, fourth paragraph. Claims 26-27 are rejected under 35 U.S.C. §103(a) over Kramling in view of Rieser, or alternatively, Rieser in view of Kramling, and further in view of U.S. Patent No. 4,910,074 ("Fukawa").

Any *prima facie* case of obviousness based on the cited prior art is rebutted by the significant reduction in injuries that result when a person strikes the recited glazing, which "in a non-intact and bent state, has a Triplex Laceration Index of 7 or less".

The cited prior art discloses laminated glass for reducing injuries to people caused by striking against intact, unbroken, glass in a laminated glazing. However, the cited prior art fails to suggest improved protection for people striking against non-intact laminated glazing.

Kramling is directed to a laminated glazing having both the high resistance to particles of thermally toughened glass and the high visibility when cracked of annealed glass. See, e.g., Kramling at column 2, lines 45-58. While Kramling's glazing contains a sheet of plastic sandwiched by two glass sheets, Kramling is silent about the thickness of the plastic sheet.

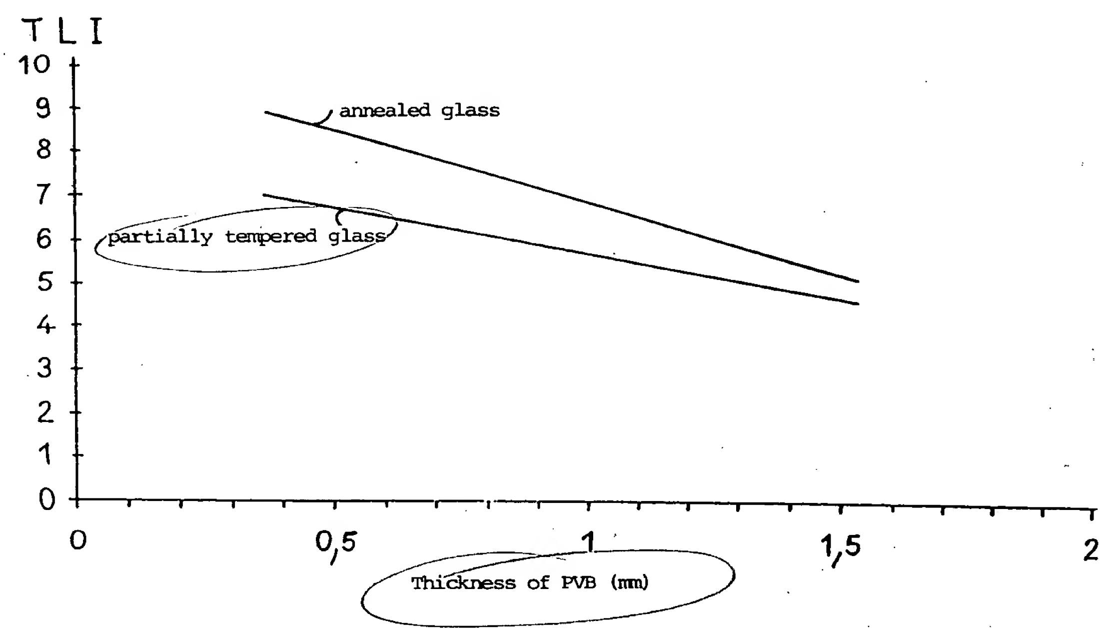
Rieser discloses laminated safety glass with two chemically tempered glass sheets. Rieser at column 3, lines 38-43, discloses that in chemical tempering, the compressive stress

can range from a relatively high level at the surfaces to zero at a depth of only a few thousandths of an inch below the surface. However, Rieser does not specify the core compressive stress in the glass sheets.

Fukawa is cited for disclosing a functional layer in a laminated glass and a plastic sheet on the laminated glass. Office Action at page 5, section 7.

The superior anti-laceration properties of the glazing produced by the claimed method are discussed in specification at Example 1 and illustrated in Fig. 1, which is reproduced below.

FIGURE 1



The partially tempered glass in Fig. 1 has a surface stress of 45 ± 10 MPa, which is equivalent to a core compressive stress in the central zone approximately equal to 22 ± 5 MPa. Specification at page 8, lines 20-21. In contrast, the annealed glass in Fig. 1 has a core compressive stress of approximately zero. Fig. 1 shows that laminated glazing produced by

the method of independent Claim 1 using the compressively stressed partially tempered glass exhibits a significantly lower TLI, indicative of lacerations of less severity, than laminated glazing produced using the non-compressively stressed annealed glass.

Because the cited prior art fails to suggest the significant reduction in injury ("Triplex Laceration Index of 7 or less") to persons upon striking non-intact and bent glazing produced according to the present invention by adhering together, with an intercalary adhesive layer having a thickness of more than 0.76 mm, two sheets of glass each having a thickness of from 1.5 to 3 mm and having a core compressive stress in the central zone ranging from 20 to 50 MPa, any *prima facie* case of obviousness is rebutted. Thus, the rejections under 35 U.S.C. § 103(a) should be withdrawn.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
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Corwin P. Umbach, Ph.D.
Registration No. 40,211

Attachment:

Pickard J., Brereton P., Hewson A.: An objective method of assessing laceration damage to simulate facial tissues - The Triplex Laceration Index - Proceeding of 17th Conference - American Association of Automotive Medicine 1973, pages 148-165

22850

(703) 413-3000
(703) 413-2220 (fax)

Proc. 17th Conference of the American Association of Automotive Medicine, Nov 1973

6000

AN OBJECTIVE METHOD OF ASSESSING LACERATION DAMAGE TO SIMULATED FACIAL TISSUES.

- THE TRIPLEX LACERATION INDEX.

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ABSTRACT

Existing laceration scales rely on subjective assessment. A new method has been devised for the quantitativ assessment of the severity of lacerations in the two layers of chamois leather and the subcutaneous tissue simulation used in laceration investigations.

The method uses a simple mathematical formula to relate the severity of laceration to the number, length and depth of cuts in the tissue simulations. The formula gives an excellent correlation with the existing scale used by Corning and was devised using the data on various levels of laceration obtained on an impact rig resembling the Corning Skull Impactor. Further studies were made to ensure that the correlation between the new scale and the Corning Scale was retained when the characteristics of the laceration differed from those with which the scale was developed.

The new scale provides a means of ranking severity of laceration and possesses the following advantages:-

1. It is substantially non-subjective, so that any two users can produce similar results; this has been a real problem up to now for workers in the field.

2. It is in very good agreement with the Corning Scale, so that results expressed in terms of the new index can be interpreted internationally with ease. This should help progress in the field of injury assessment.

3. In contrast with other scales in common use, it is continuous and is not limited at the severe end of the Scale.

The new index has been called the Triplex Laceration Index.

ONE OF THE WAYS OF TESTING THE SAFETY OF VEHICLES and their components is by the use of simulated crashes. Such tests may involve the use of dummies simulating human beings or other devices selected to simulate particular parts or actions of the human body. In these tests it is desired to obtain a measure of the damage that would be sustained by a human being in similar circumstances. In the testing of windshields in particular, this is generally achieved by m asuring the acceleration pulses and the facial lacerations sustained by the head of an anthropomorphic dummy or similar simulation. A medical interpretation is then placed on these measurements to estimate the degree of injury that a human being would be expected to suffer in similar circumstances. There are thus two distinct but dependent stages: measurement and interpretation.

In the case of head acceleration the measurement by means of accelerometers can be made with some precision. The interpretation is less precise, but attempts have been made by use of various criteria such as the Gadd Severity Index (1)* and the Head Injury Criterion (2) to relate acceleration measurements to injury in medical terms. In the case of facial laceration the situation is much less precise. Both the measurement of laceration on simulations of skin and subcutaneous tissue and their interpretation in terms of the expected severity of injury have been a matter of skilled subjective judgement.

The chief purpose of the work described in this paper has been to devise a method for the measurement of laceration of a facial tissue simulation that is both objective and precise.

SHORTCOMINGS OF EXISTING SCALES - Other workers in the field have attempted to produce numerical ranking scales of the severity of general facial laceration (3) (4) (5) (6). The Corning Scale (3) is one of the most comprehensive and widely used. It uses a skin and subcutaneous tissue simulation consisting of two chamois leathers covering an underlying layer of rubber. Many other ranking scales in use at present are derived from it or generally correspond to it. Our reasons for devising a new index are discussed

*Numbers in parenthesis designate References at end of paper.

below, with particular reference to the Corning Scale although the remarks apply in general terms to the other scales in use.

The existing scales to which reference has been made lay down a series of criteria by which the laceration can be assessed. They cannot cover all the possibilities. For example, the Corning Scale deals specifically with combinations of up to three cuts. The more specific a scale is in differentiating between different combinations the more difficult it is to resolve the inevitable anomalies. The investigator is caught between the need for rigorous, impartial assessment and the inadequacy of a scale which leads him to interpret the scale rather more flexibly. This is perhaps best illustrated by example. A particular combination of lacerations that has frequently occurred is such that when an assessment is attempted using the scale shown in Fig.1 the position is as follows:

> There are a few very small cuts through the inner chamois leather that on a rigorous interpretation of the scale would merit 5 or 6. The remaining damage merits only 3 on the scale. A rigid interpretation is thus 5 or 6; a flexible one, 3 or 4.

The dangers are evident, since some cases of lacerative damage will be placed into higher categories by the technicalities of a rigorous interpretation. A "common-sense" interpretation depends heavily on the skill of the individual assessor, and thus endangers the impartiality of the result. A consequence of these different modes of interpretation is that the results of independent investigators cannot be compared directly.

A further objection to a rigorous interpretation of these scales is that, depending on the particular test method, some categories do not occur. In our own experience, using the Corning Scale, category 7 never occurred since whenever more than "two or three cuts through to $1\frac{1}{2}$ inches" occurred, substantial damage also occurred to the rubber. Similarly cuts through the inner chamois between $\frac{3}{4}$ inch and $1\frac{1}{2}$ inches usually caused some damage to the rubber so category 6 seldom occurred. A possible solution to these difficulties is embodied in the "Wayne Scale" (4) where the number of categories has been reduced to an extent that there is no difficulty in deciding which category is applicable. The obvious shortcoming of this approach is that the coarseness of the scale requires either a very substantial change in

CORNING SCALE

Degree	Outer Chamois	Inner Chamois	Rubber Dummy Face
0	None	None	None
1-Minimal	Abrasions. Cuts to $\frac{3}{4}$" - none through.	None	None
2- Minor	Abrasions. Cuts over $\frac{3}{4}$", none through.	None	None
3-Minor	As (2) above, but one $\frac{3}{4}$" cut through.	Abrasions	None
4-Moderate	Two or three $\frac{3}{4}$" cuts through.	Cuts, but not through.	None
5-Moderate	Unlimited cuts	Only one cut through to $\frac{3}{4}$"	None
6-Severe	Unlimited Cuts	Two or three cuts through to $1\frac{1}{2}$"	None
7-Severe	Unlimited cuts	Unlimited cuts	Abrasions
8-Severe	Unlimited cuts	Unlimited cuts	Cuts up to 1/32" deep and $\frac{3}{4}$" long.
9- Very Severe	Unlimited cuts	Unlimited cuts	One cut deeper or longer than (8)
10-Very Severe	Unlimited cuts	Unlimited cuts	Numerous cuts worse than (9).

Fig.1. Corning Scale.

laceration or an excessive number of tests to establish a change in the level of lacerative damage.

Yet another defect in existing scales is that they impose an artificial limit to the scaling of injuries at the severe end of the range. For example, the category 10 on the Corning Scale includes all lacerations which rank above category 9, no matter how severe. In reality, there is no

natural limit to laceration severity which can be determined without detailed knowledge of the function of the tissue lacerated.

For these reasons, we concluded that there was a need for a scale which relied solely upon definite measurements and from which the overall severity can be calculated without the need to apply subjective judgement.

DEVELOPMENT OF NEW INDEX.

OBJECTIVES - We set out to devise an index of laceration, such that :

1. Subjectivity in laceration measurement and assessment would be reduced to a minimum.
2. The index values should increase continuously so as to reduce the extra scatter in experimental results which an integer scale produces.
3. The scale should not be artificially bounded at the severe injury end.
4. The values of the index should if possible be related to existing scales so as to allow comparison of results with previously published work.

IMPACT APPARATUS AND HEADFORM SIMULATION - In order to provide data upon which to work 50 impacts were performed simulating the impact of an unrestrained front-seat car passenger into a windshield during a crash. A pivoting headform apparatus similar to the Corning Skull Impact Rig(3) was used for the impacts. The rig is shown diagrammatically in Figs. 2 and 3. The headform was covered with two layers of moist, selected chamois leather. Beneath the leathers was a replaceable rubbery skull-cap made of p.v.c. material of about 6mm thick. Chamois leathers were used in order to conform to established practice. The use of a replaceable skull-cap is believed to be an innovation. The materials were chosen to comply as nearly as possible with the SAE recommended practice (Appendix 1). The leathers and skull- cap were used only once. The velocity of the impacts was varied to give a range of lacerative damage. A panel of three experienced assessors agreed and assigned a number from the Corning Scale to the lacerative damage resulting from each of the impacts.

DERIVATION OF TRIPLEX LACERATION INDEX (T.L.I.) - Using these results as a reference, we sought to find some function of the actual numbers, lengths and depths of the lacerations present in the simulated tissues which could be

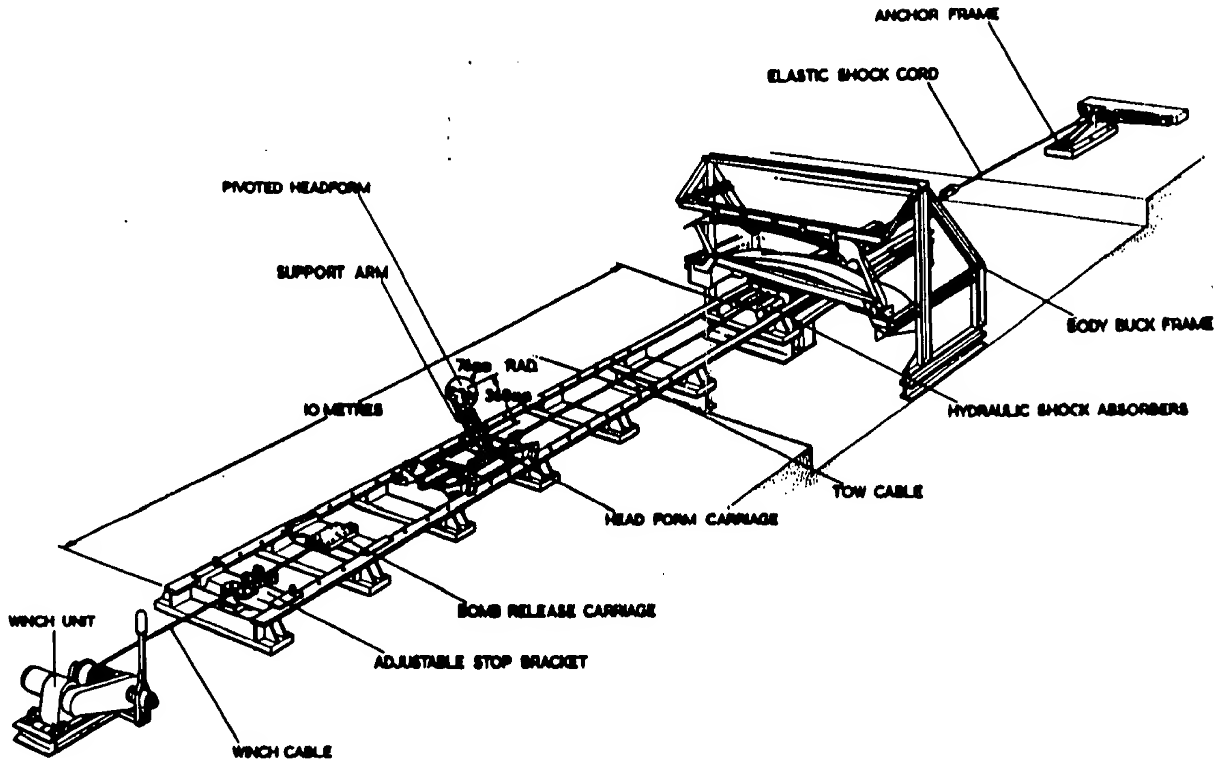

Fig. 2. The skull impact test rig.

LENGTH OF ARM	368 mm
WEIGHT OF HEADFORM & ARM	6·8kg
RADIUS OF HEADFORM	76mm
WEIGHT OF TROLLEY	45kg
ANGLE OF HEADFORM TO ARM	45°

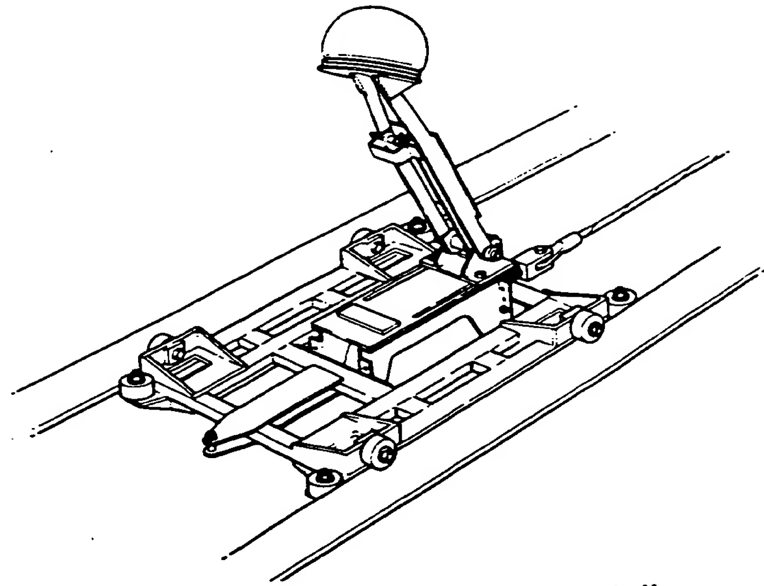

Fig.3. Details of the trolley from the skull impact rig.

used as a laceration index.

So as to minimise subjectivity in the assessment it was decided to count only those cuts in the leathers which had actually penetrated to the inner surface. When the leathers are viewed under slight tension on an illuminated screen it is then very easy to measure the length of each penetrating cut. For damage to the p.v.c. skull-cap a measurement of length was taken for each cut. This was the length (curved length where appropriate) over which the depth of the cut exceeded 0.5mm. In every case th measurement was rounded up or down to the nearest integral number of millimetres. The maximum depth of each cut into the skull-cap was measured to the nearest whole millimetre and the slant depth was used in the case of inclin ed cuts.

Thus th following measurem nts were obtained:

s, d, n_{isd}

Where $s = (1,2,3,...s_{max})$ are the length of cuts rounded to the nearest mm.

$d = (1,2,3,...d_{max})$ are the depth of cuts rounded to the nearest mm. In the case of the chamois leathers a value of d=1 is assumed (because of the thickness of leather and measurement criteria used).

n_{isd} are the number of cuts of length s and depth d in the ith component.

and

$i = 1$ for the outer leather;
$i = 2$ for the inner leather; and
$i = 3$ for the p.v.c. skull-ca p

These measurements can be organised conveniently into the standard format exemplified in Fig.4.

The problem then became one of finding a sensible way of combining the s, d and n_{isd} to give a function F satisfying the requirements. The method used was to attempt to find a suitable formula incorporating these measurements and some undetermined parameters. A least squares criterion was employed to derive the valdes of the parameters. That is, the sum of squares

$$\sum_{k=1}^{m} (C_k - F_k)^2$$

Where C_k = the Corning assessment of the kth set of leathers and p.v.c.,

and F_k = the trial function evaluated for the kth set of leathers and p.v.c.

m = the total number of impact events

was used as a measure of the deviation of the trial laceration

Impact Number: T 322

Glass Details: 3mm (A) - 0.76mm H.P.R. - 3mm (A)

Impact Velocity: 24 Km/h (15 m.p.h.)

P.V.C.			INNER		OUTER	
No.	Length (mm)	Depth (mm)	No.	Length (mm)	No.	Length (mm)
1	20	2	3	30	2	40
1	15	1	2	25	2	30
1	10	1	1	2	1	25
1	6	1	2	1	5	20
0	0	0	0	0	4	10
					2	6
					4	5
					2	2
					0	0

TRIPLEX LACERATION INDEX

Sample No. 322

Triplex Laceration Index = 9.77

Fig.4. Format for recording laceration data.

index F from the Corning assessment C. A computerised minimisation routine was used to adjust each of the parameters in the trial expression for F so as to minimise the sum of squares. The values of the adjustable parameters to give the optimum fit of the trial function F to the Corning Scale were thus found. In this optimisation procedure, the data associated with Corning values 0,1,2 and 10 were ignored because :-

(a) Corning values 0,1,and 2 implied cuts not penetrating the thickness of the first leathers. (For the use of these values see under "Final Index" below).

(b) 10 is the upper bound of the Corning Scale and hence could conceal data which would need to be fitted to values in excess f ten on the new scale.

First attempts to find a suitable function F involved expressions of the form:-

$$F = 2 + \sum_{i=1}^{3} A_i \sum_{s=1}^{s_{max}} \sum_{d=1}^{d_{max}} n_{isd}\, s^{p_i} d^{q} \qquad (1)$$

Where A_i, p_i, q were the parameters to be determined. This gave a scale which appeared to rank the injuries sensibly but was a poor fit to the Corning Scale. Because of the nature of the misfit a logarithmic expression of the form

$$F = 2 + A_o \log_{10} \left\{ 1 + \sum_{i=1}^{3} A_i \sum_{s=1}^{s_{max}} \sum_{d=1}^{d_{max}} n_{isd}\, s^{p_i} d^{q} \right\} \qquad (2)$$

was tried. This was found to be an excellent fit to the Corning Scale.

The values for p_1, p_2, p_3 which emerged were in the range of 1.8 to 2.2.

The value for A_o was close to 1.

The value for q was close to 3.

Simplifying values of

$$p_1 = p_2 = p_3 = 2$$
$$A_o = 1$$
$$q = 3$$

were assumed in addition to the assumed values of d=1 for the leathers. The expression (2) was re - optimised and yielded the following values for the other coefficients -

$$A_1 = 1.16$$
$$A_2 = 50.8$$
$$A_3 = 16,500$$

The goodness of fit obtained with these parameters was still excellent as can be seen by reference to Fig.5.

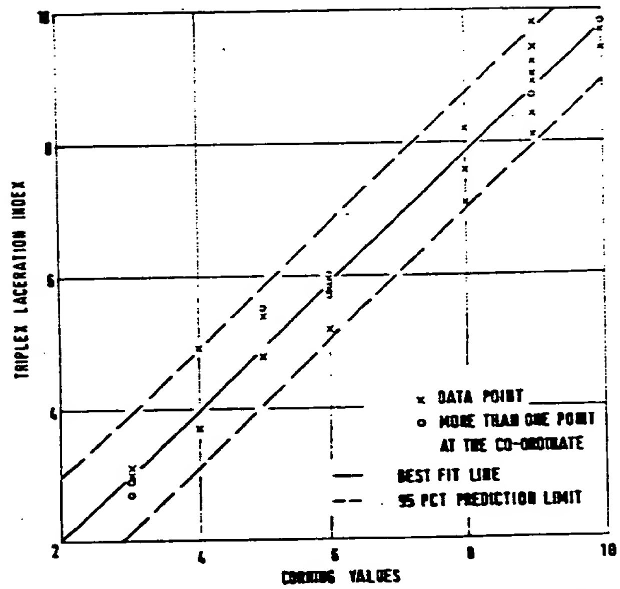

Fig.5 Plot of T.L.I. against corning values - initial skull impact data used in T.L.I. derivation.

FINAL INDEX - The final expression for the Triplex Laceration Index can be written -

$$T.L.I. = 2+\log_{10}(1+1.16D_1+50.8D_2+16,500D_3) \quad (3)$$

where

$$D_1 = \sum_{s=1}^{s_{max}} n_{1s}s^2$$ is the lacerative damage to the outer leather. (4)

$$D_2 = \sum_{s=1}^{s_{max}} n_{2s}s^2$$ is the lacerative damage to the inner leather (5)

and

$$D_3 = \sum_{d=1}^{d_{max}} \sum_{s=1}^{s_{max}} n_{3sd}s^2 d^3$$ is the lacerative damage to the p.v.c. (6)

Steht nicht in aller Veröffentlichung

For the evaluation of lacerations which do not penetrate through the first leather, the Corning rating is applied. At this end of the scale the normal assessment is, in any case, least subjective.

USE OF THE INDEX - The T.L.I. index has been in continuous use in the Technical Centre of Triplex Safety Glass Co.Ltd. for almost two years. Samples of leathers and p.v.c. skull-caps have been checked periodically by assessing them on the Corning Scale. The assessment was performed with the same degree of rigour as was used for the first trial batch. The correspondence has remained good as can be seen in Fig.6.

The index has also been used to evaluate lacerations produced by different test methods. Both dropping headform and anthropomorphic dummy tests have been performed. The correspondence with the Corning Scale has remained the same, indicating that there are no difficulties in applying the index to different testing procedures. The correlation for 38 anthropomorphic dummy impacts is shown in Fig. 7. It must be made clear that we used a consistent and rigorous interpretation of the Corning Scale as this was the only way to maintain continuity over a period of time. Batches of leathers and p.v.c. have similarly been assessed by different people independently. In general we have found that two careful assessments using the T.L.I. will not differ by more than 0.3 units despite the apparent difficulty of accurately measuring a large amount of complicated lacerations. The reason for this is that because of the weights attached to the lacerations of the different strata of tissue simulation :-

1. If the p.v.c. is badly damaged then all damage to the leathers can be ignored.

2. If the p.v.c. is slightly damaged then all damage to the outer leathers can be ignored.

3. If the inner leather is badly damaged then all damage to the outer leather can be ignored.

This makes the measurement task much easier and if care is taken to measure the most severe damage accurately, mismeasurement of the more minor damage is of little consequence. The measurement of lacerative damage usually takes only a few minutes and the subsequent calculation of the T.L.I. can be performed conveniently and quickly on a desk calculator.

INTERPRETATION OF THE T.L.I. - The quantity

$$1.16D_1 + 50.8\ D_2 + 16{,}500\ D_3$$

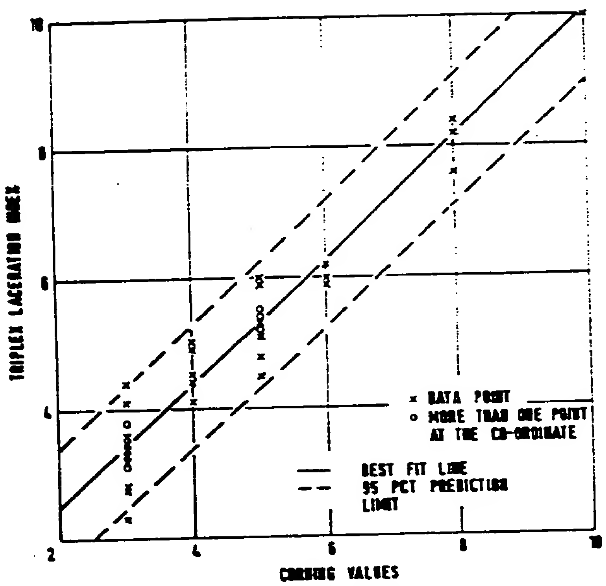

Fig.6. Plot of T.L.I. against corning values - more recent skull impact data.

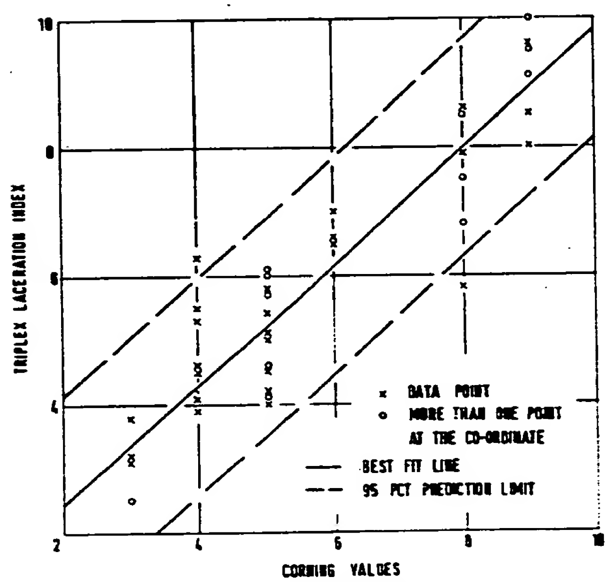

Fig.7. Plot of T.L.I. against Corning values - anthropomorphic dummy tests.

is a measure of the Total Lacerative Damage to the chamois leathers and p.v.c. The index T.L.I. is then related to this by the expression -

$$\text{T.L.I.} = 2 + \log_{10}(1+ \text{Total Lacerative Damage}).$$

From this it can be seen that a change of one unit in the T.L.I. is brought about by a change by about a factor of ten in the Total Lacerative Damage. By closer investigation of the formulae (3), (4), (5) and (6) it can be seen similarly that a unit change in T.L.I. can be brought about by -

1. A tenfold change in the number of cuts (length and depth of cuts remaining constant).
2. A threefold change in length of cuts (number and d pth of cuts remaining constant).
3. A twofold change in depth of cuts into the p.v.c. once serious damage to the p.v.c. has occurred (length and number remaining constant).

This sort of quantitative interpretation is a feature which is not found with existing laceration scales.

In practice, a change of one unit would include contributions from all three sources, number, length and depth. An actual example of a one unit change from 11 to 10 T.L.I. units was made up of :-

(a) a 50% change in the average number of cuts to the p.v.c. and inner leather; together with

(b) a 50% change in the average length of cuts to the p.v.c. and inner leather; with

(c) no change in the average depth of cuts, or in the damage to the outer leather.

Samples of leathers and p.v.c. skull-caps chosen to exemplify the laceration damage corresponding to T. L. I. values of 6, 8, 10 and 12 units are illustrated in Figs. 8, 9, 10 and 11.

CONCLUSIONS

The T.L.I. as a means of measurement and ranking of laceration has the following properties and has fulfilled the requirements mentioned earlier in the paper in that :-

1. It is objective.
2. Theoretically, it has no upper limit although in practice values greater than 13 have not been experienced.
3. It is continuous for values of T.L.I. greater than 2.
4. It is in good agreement with the Corning Scale

Fig.8. Facial tissue simulation used on the skull impact test rig. T.L.I. = 6.

Fig.9. Facial tissue simulation used on the skull impact test rig T.L.I. = 8.

Fig.10. Facial tissue simulation used on the skull impact test rig. T.L.I. = 10.

Fig.11. Facial tissue simulation used on the skull impact test rig. T.L.I. = 12.

between the values of 2 and 9.

5. The correlation of the Index with the Corning Scale does not depend on the method used to produce the laceration.

6. By reference to the mathematical formulation each unit change of T.L.I. can be interpreted quantitatively in terms of length, number and depth of the cuts forming the total laceration damage.

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ACKNOWLEDGMENTS.

The authors wish to acknowledge the assistance of Mr. R. Challis and Mr. K. W. J. Fickert of Triplex Safety Glass Co. Ltd. and the permission of the Directors of Triplex Safety Glass Co.Ltd. to publish this paper.

APPENDIX 1.

FACIAL TISSUE SIMULATIONS.

CHAMOIS LEATHERS - Two moist chamois leathers were used to simulate facial skin. 300mm (12") diameter circles of chamois leather for impact work were selected by the following procedure:-

1. Visual Grading. Each leather as received was placed on a light box to check for uniformity in appearance. Any leathers having a non-uniform appearance (displaying

streaks or patch s) were rejected.

2. Thickness Measur ments. Four measurements were taken on ach circle : at the centre and at three locations near th periphery, approximately 120° apart. A spring - loaded dial gauge fitted with a 20mm diameter measuring platen was used. Acceptable thickness tolerance for impact work was 1mm ± 0.2mm (0.040" ± .008").

3. Cuttability. Leathers to be used for impact work were tested at intervals for cuttability, using a Hounsfield tensometer, with a special jig, which employs a commercial razor-blade to produce a 25mm (1") cut in the test piece. The test piece was a small sample 15mm x 75mm (½" x 3") cut from just outside the circle. The force to cut through the leather was recorded, the acceptance range being 1.6Kg (3.5 lbs) to 2.4 Kg (5.25 lbs) for a 25mm (1") cut.

4. Pairing. Leathers from a given batch were paired so as to take into account the slight variations in thickness which existed within the specification. The thickest was paired with the thinnest, the thickest but one with the thinnest but one, etc. The thinner leather of a given pair always constituted the outer layer of a pair.

REPLACEABLE SKULL-CAP - The material used was a hot-melt p.v.c. (melting point approximately 200°C) with a self-contained mould release agent. The p.v.c. has a low viscosity in its molten form and is simply poured into alloy moulds. Metal moulds have been found to give the most satisfactory finish, free of voids and air pockets.

The material has the following properties at room temperature.

(a)	Tensile Strength	98 KN/m^2 (140 psi.)
(b)	Elongation	600%
(c)	Shore hardness	20°C
(d)	Thickness	6.5mm (0.25")

The p.v.c. material used is marketed under the name VINAMOLD (brown) by:

Norman & Raymond,
122 Stonehouse Street,
Clapham.
London. S.W.4 U.K.

This material was chosen since its properties were as close as could be found to the recommendations of SAE Recommended Practice J.984.